

What is claimed:

1. A kit providing pre-measured amounts of components to form a fluorocarbon nutrient emulsion capable of carrying oxygen to living tissue, the kit comprising:

5 constituent solutions, emulsions or particle compositions, which are the constituent compositions, containing pre-measured amounts of components for making the fluorocarbon nutrient emulsion, the constituent compositions comprising:

poly-fluorinated, oxygen-carrying compound;

10 a physiologically acceptable emulsifying agent effective to emulsify the polymer;

a nutrient-providing effective amount of carbohydrate;

nutrient-providing effective amounts of amino acids or amino acid precursors;

15 an oncotic agent in amount effective to provide, in conjunction with the other components of the solution, a physiologically acceptable oncotic pressure; and

sufficient salts and buffering agents to provide a physiological osmotic pressure and physiologically appropriate concentrations of

20 potassium and sodium ions;

wherein constituent compositions are selected to allow for sufficient stability of the components to allow for commercial marketing of the kit.

2. The kit of claim 1, wherein there are no more than eight constituent  
25 compositions.

3. The kit of claim 1, wherein there are no more than four constituent compositions.

30 4. The kit of claim 1, wherein at least three of constituent compositions are packaged together in separate chambers of a multi-chambered bag having pressure release seams separating the chambers, whereby pressure can be used to break the

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barriers between chambers to allow the contents to mix, wherein the contents mix to provide the appropriate concentrations.

5. The kit of claim 4, wherein the multi-chambered bag, or the  
 5 multi-chambered bag together with a bag that envelops the multi-chambered bag has an  
 carbon dioxide permeability of  $10 \text{ cc/m}^2 \cdot \text{day} \cdot \text{atm}$  or less.

6. The kit of claim 4, wherein the multi-chambered bag, or the  
 multi-chambered bag together with a bag that envelops the multi-chambered bag has an  
 10 carbon dioxide permeability of  $1.0 \text{ cc/m}^2 \cdot \text{day} \cdot \text{atm}$  or less.

7. The kit of claim 4, wherein the multi-chambered bag, or the  
 multi-chambered bag together with a bag that envelops the multi-chambered bag has an  
 carbon dioxide permeability of  $0.5 \text{ cc/m}^2 \cdot \text{day} \cdot \text{atm}$  or less.

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8. The kit of claim 1, wherein the constituent compositions are adapted to provide a fluorocarbon nutrient emulsion with the following component amounts:

Poly-Fluorinated, Oxygen-Carrying Compound, %v/v	9.5-10.5
Phospholipid, mg/mL	11.5
Albumin, g/dL,	1.67
$\alpha$ -Ketoglutaric Acid, $\mu\text{g/mL}$	25
Amino Acids, $\mu\text{g/mL}$	
L-Isoleucine+L-Leucine	17.5
L-Valine	16.6
L-Alanine	28.6
L-Serine	24.6
L-Histidine	10.3
L-Methionine	2.1
L-Phenylalanine+L-Lysine	35.3
L-Threonine+L-Arginine	48.3
L-Tyrosine	7.9
Na <sup>+</sup> , mM	147
K <sup>+</sup> , mM	2.9
Cl <sup>-</sup> , mM	130
Ca <sup>+2</sup> , mM	1.15
Mg <sup>+2</sup> , mM	1.12
Glucose (dextrose), mg/dL	94

9. A kit providing pre-measured amounts of components to form a fluorocarbon nutrient emulsion capable of carrying oxygen to living tissue, the kit comprising: constituent solutions, emulsions or particle compositions, which are the 5 constituent compositions, containing pre-measured amounts of components for making the fluorocarbon nutrient emulsion, the constituent compositions comprising:

10 a first constituent composition comprising an emulsion of poly-fluorinated, oxygen-carrying compound;

15 a second constituent composition comprising a solution of sodium and potassium salts;

20 a third constituent composition comprising a solution of a nutrient-providing effective amount of glucose;

a fourth constituent composition comprising a solution of an oncotic agent in amount effective to provide, in conjunction with the other components of the fluorocarbon nutrient emulsion, a physiologically acceptable oncotic pressure;

a fifth constituent composition comprising solution of nutrient-providing effective amounts of amino acids; and

a sixth constituent composition comprising a nutrient-providing effective amount of  $\alpha$ -ketoglutaric acid.

10. The kit of claim 9, wherein the second constituent composition comprises one or both of calcium and magnesium salts.

25 11. The kit of claim 9, wherein the fifth constituent composition comprises nutrient-providing effective amounts of arginine, histidine, leucine, lysine, methionine, phenylalanine, threonine and valine, and all of the components are essentially lacking in glutamic acid, glutamine and glycine.

30 12. A kit providing pre-measured amounts of components to form a fluorocarbon nutrient emulsion capable of carrying oxygen to living tissue, the kit comprising: constituent solutions, emulsions or particle compositions, which are the

constituent compositions, containing pre-measured amounts of components for making the fluorocarbon nutrient emulsion, the constituent compositions comprising:

- 5 a first constituent composition comprising an emulsion of poly-fluorinated, oxygen-carrying compound;
- 10 a second constituent composition comprising a solution of sodium, potassium, magnesium and calcium salts;
- a third constituent composition comprising a solution of oncotic agent in an amount effective to provide, in conjunction with the other components of the fluorocarbon nutrient emulsion, a physiologically acceptable oncotic pressure; and
- 15 a fourth constituent composition comprising solution of a nutrient-providing effective amounts of amino acids,  
wherein either the second constituent composition comprises a nutrient-providing effective amount of glucose or the kit comprises a fifth constituent composition comprising a nutrient-providing effective amount of glucose.

13. The kit of claim 12, wherein the first constituent composition comprises a nutrient-providing effective amount of  $\alpha$ -ketoglutaric acid.

20 14. The kit of claim 12, wherein the fourth constituent composition comprises a nutrient-providing effective amount of  $\alpha$ -ketoglutaric acid.

15. The kit of claim 12, wherein the second constituent composition comprises a nutrient-providing effective amount of glucose.

25 16. The kit of claim 15, wherein one or more of the second and fourth constituent compositions is in dried form adapted to be diluted in a pre-determined amount of water prior to use.

30 17. The kit of claim 12, wherein the kit comprises the fifth constituent composition.

18. The kit of claim 23, wherein one or more of the second, fourth and fifth constituent compositions is in dried form adapted to be diluted in a pre-determined amount of water prior to use.

5 19. The kit of claim 12, wherein at least the first, second and fourth constituent compositions are packaged together in separate chambers of a multi-chambered bag having pressure release seams separating the chambers, whereby pressure can be used to break the barriers between chambers to allow the contents to mix, wherein the contents mix to provide the appropriate concentrations.

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20. The kit of claim 19, wherein the multichambered bag has an injection port through which the third constituent composition can be injected to complete the fluorocarbon nutrient emulsion.

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21. The kit of claim 12, wherein the first, second, third and fourth constituent compositions are packaged together in separate chambers of a multi-chambered bag having pressure release seams separating the chambers, whereby pressure can be used to break the barriers between chambers to allow the contents to mix, wherein the contents mix to provide the appropriate concentrations.

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22. A fluorocarbon nutrient emulsion with the following component amounts:

Poly-Fluorinated, Oxygen-Carrying Compound, %v/v	9.5-10-5
Albumin, g/dL,	1.67
$\alpha$ -Ketoglutaric Acid, $\mu$ g/mL	25

Amino Acids, $\mu\text{g/mL}$	
L-Isoleucine+L-Leucine	17.5
L-Valine	16.6
L-Alanine	28.6
L-Serine	24.6
L-Histidine	10.3
L-Methionine	2.1
L-Phenylalanine+L-Lysine	35.3
L-Threonine+L-Arginine	48.3
L-Tyrosine	7.9
$\text{Na}^+$ , mM	147
$\text{K}^+$ , mM	2.9
$\text{Cl}^-$ , mM	130
$\text{Ca}^{+2}$ , mM	1.15
$\text{Mg}^{+2}$ , mM	1.12
Glucose (dextrose), mg/dL	94

23. A vehicle kit providing pre-measured amounts of components to form a vehicle corresponding to a fluorocarbon nutrient emulsion formed from a corresponding fluorocarbon nutrient emulsion kit,

5 the corresponding fluorocarbon nutrient emulsion kit comprising constituent solutions, emulsions or particle compositions, which are the first constituent compositions, containing pre-measured amounts of components for making the fluorocarbon nutrient emulsion, the first constituent compositions made up of:

10 (a) poly-fluorinated, oxygen-carrying compound;

(b) a phospholipid emulsifying agent effective to emulsify the poly-fluorinated, oxygen-carrying compound, wherein the poly-fluorinated, oxygen-carrying compound and the phospholipid emulsifying agent are supplied in one first constituent composition wherein the poly-fluorinated, oxygen-carrying compound is emulsified by the phospholipid emulsifying agent, this emulsified poly-fluorinated, oxygen-carrying compound composition providing a portion of sodium or potassium ions of the fluorocarbon nutrient emulsion;

15 (c) a nutrient-providing effective amount of carbohydrate;

(d) nutrient-providing effective amounts of amino acids or amino acid precursors;

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(e) an oncotic agent in amount effective to provide, in conjunction with the other components of the fluorocarbon nutrient emulsion, a physiologically acceptable oncotic pressure; and

(f) sufficient salts and buffering agents to provide a physiological osmotic pressure and physiologically appropriate concentrations of potassium and sodium ions;

5 the vehicle kit comprising the following separate vehicle kit compositions:

all the first constituent compositions but the emulsified poly-fluorinated, oxygen-carrying compound composition; and

10 supplement constituent compositions comprising one or more components effective to supply the sodium or potassium ions that would be provided by the emulsified poly-fluorinated, oxygen-carrying compound composition.

24. The vehicle kit of claim 23, wherein the vehicle kit compositions of the  
15 corresponding fluorocarbon nutrient emulsion kit comprise:

(1) a first constituent composition comprising an emulsion of poly-fluorinated, oxygen-carrying compound;

(2) a first constituent composition comprising a solution of sodium, potassium, magnesium and calcium salts;

20 (3) a first constituent composition comprising a solution of a nutrient-providing effective amount of glucose;

(4) a first constituent composition comprising a solution of an oncotic agent in amount effective to provide, in conjunction with the other components of the fluorocarbon nutrient emulsion, a physiologically acceptable oncotic pressure;

25 (5) a first constituent composition comprising a solution of nutrient-providing effective amounts of amino acids; and

(6) a first constituent composition comprising a nutrient-providing effective amount of  $\alpha$ -ketoglutaric acid,

30 whereby the vehicle kit compositions comprise first constituent compositions (2) through (6) and at least one supplement constituent composition.

25. The vehicle kit of claim 23, wherein the vehicle kit compositions of the corresponding fluorocarbon nutrient emulsion kit comprise:

- (1) a first constituent composition comprising an emulsion of poly-fluorinated, oxygen-carrying compound;
- 5 (2) a first constituent composition comprising a solution of sodium, potassium, magnesium and calcium salts;
- (3) a first constituent composition comprising a solution of the oncotic agent in amount effective to provide, in conjunction with the other components of the fluorocarbon nutrient emulsion, a physiologically acceptable oncotic 10 pressure; and
- (4) a first constituent composition comprising a solution of a nutrient-providing effective amounts of amino acids,

whereby the vehicle kit compositions comprise first constituent compositions (2) through (4) and at least one supplement constituent composition.

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26. The vehicle kit of claim 23, wherein the supplement constituent compositions are effective to supply the  $\alpha$ -ketoglutaric acid that would be provided by the emulsified poly-fluorinated, oxygen-carrying compound composition.

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27. The vehicle kit of claim 23, wherein the supplement constituent compositions are effective to supply the phospholipid emulsifying agent that would be provided by the emulsified poly-fluorinated, oxygen-carrying compound composition.

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28. A kit for use in delivering a fluorocarbon nutrient emulsion comprising

(a) the vehicle kit of claim 23 and (b) the corresponding fluorocarbon nutrient emulsion kit.

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29. The vehicle kit of claim 23, wherein vehicle kit compositions and supplement and one or more supplement compositions adapted to provide a vehicle solution with the following component amounts:

Albumin, g/dL,	1.67
$\alpha$ -Ketoglutaric Acid, $\mu$ g/mL	25

Amino Acids, $\mu\text{g/mL}$	
L-Isoleucine+L-Leucine	17.5
L-Valine	16.6
L-Alanine	28.6
L-Serine	24.6
L-Histidine	10.3
L-Methionine	2.1
L-Phenylalanine+L-Lysine	35.3
L-Threonine+L-Arginine	48.3
L-Tyrosine	7.9
$\text{Na}^+$ , mM	147
$\text{K}^+$ , mM	2.9
$\text{Cl}^-$ , mM	130
$\text{Ca}^{+2}$ , mM	1.15
$\text{Mg}^{+2}$ , mM	1.12
Glucose (dextrose), mg/dL	94

30. The vehicle kit of claim 23, adapted to provide a vehicle solution with the following further component amount:

Phospholipid, mg/mL	11.5
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31. The vehicle kit of claim 23, comprising:

a first vehicle kit composition comprising a solution of (i) sodium, potassium, magnesium and calcium salts, (ii) a nutrient-providing effective amount of  $\alpha$ -ketoglutaric acid, and (iii) a nutrient-providing effective amounts of amino acids;

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a second vehicle kit composition comprising a solution of the oncotic agent in amount effective to provide, in conjunction with the other components of the fluorocarbon nutrient emulsion, a physiologically acceptable oncotic pressure; and

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a third vehicle kit composition comprising a solution of a nutrient-providing effective amount of glucose.

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32. A vehicle solution with the following component amounts:

Albumin, g/dL,	1.67
$\alpha$ -Ketoglutaric Acid, $\mu$ g/mL	25
Amino Acids, $\mu$ g/mL	
L-Isoleucine+L-Leucine	17.5
L-Valine	16.6
L-Alanine	28.6
L-Serine	24.6
L-Histidine	10.3
L-Methionine	2.1
L-Phenylalanine+L-Lysine	35.3
L-Threonine+L-Arginine	48.3
L-Tyrosine	7.9
$\text{Na}^+$ , mM	147
$\text{K}^+$ , mM	2.9
$\text{Cl}^-$ , mM	130
$\text{Ca}^{+2}$ , mM	1.15
$\text{Mg}^{+2}$ , mM	1.12
Glucose (dextrose), mg/dL	94

33. A method of delivering a fluorocarbon nutrient emulsion to neural tissue

5 of an animal having a cerebrospinal pathway, the method comprising:

- (a) inserting a first catheter at a first point directed to deliver fluid to a cerebral ventricle;
- (b) inserting a second catheter at a second point lower in the cerebrospinal pathway, which point is adapted to drain excess fluid due to fluid insertion through the first catheter;
- (c) inserting through the first catheter a vehicle solution adapted to be physiologically compatible with the fluorocarbon nutrient emulsion, wherein the vehicle solution lacks sufficient oxygen carrying capacity to be capable of carrying a respiration-supporting amount of oxygen;
- (d) confirming with the vehicle solution the existence of a perfusion pathway from the first catheter to the second catheter;
- (e) if necessary, repositioning one or both of the catheters and repeating step (d) until a perfusion pathway is confirmed; and
- (f) once a perfusion pathway is confirmed, inserting an oxygenated fluorocarbon nutrient emulsion through the first catheter.

34. A fluorocarbon nutrient emulsion capable of carrying oxygen to living tissue or a kit of pre-measured components for such a solution, the solution or kit comprising:

- a poly-fluorinated, oxygen-carrying compound;
- 5 a physiologically acceptable emulsifying agent effective to emulsify the poly-fluorinated, oxygen-carrying compound; and
- nutrient-providing effective amounts of amino acids or amino acid precursors, wherein the solution or kit is essentially lacking in glutamic acid, glutamine and glycine.

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35. The fluorocarbon nutrient emulsion or kit of claim 34, further comprising a nutrient-providing effective amount of carbohydrate.

36. The fluorocarbon nutrient emulsion or kit of claim 34, wherein the 15 nutrient-providing effective amounts of amino acids or amino acid precursors comprise a nutrient-providing effective amount of a precursor to glutamic acid or glutamine which is citric acid, cis-aconitic acid, isocitric acid,  $\alpha$ -ketoglutaric acid, succinic acid, fumaric acid, malic acid or oxaloacetic acid or a pharmaceutically acceptable salt thereof.

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37. A nutrient solution or a kit of pre-measured components for such a solution, the solution or kit comprising:

- a nutrient-providing effective amount of carbohydrate;
- an oncotic agent in amount effective to provide, in conjunction with the other 25 components of the solution, a physiologically acceptable oncotic pressure;
- and
- nutrient-providing effective amounts of amino acids or amino acid precursors including arginine, histidine, leucine, isoleucine, lysine, methionine, phenylalanine, threonine and valine, wherein the solution or kit is essentially lacking in glutamic acid, glutamine and glycine.

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38. The nutrient emulsion or kit of claim 37, wherein the nutrient-providing effective amounts of amino acids or amino acid precursors comprise a nutrient-providing effective amount of  $\alpha$ -ketoglutaric acid or a pharmaceutically acceptable salt thereof.

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39. A fluorocarbon nutrient emulsion capable of carrying oxygen to living tissue or a kit of pre-measured components for such a solution, the solution or kit comprising:

5 a poly-fluorinated, oxygen-carrying compound;  
a physiologically acceptable emulsifying agent effective to emulsify the poly-fluorinated, oxygen-carrying compound; and  
nutrient-providing effective amounts of amino acids or amino acid precursors, including at least one citric acid, cis-aconitic acid, isocitric acid, succinic  
10 acid, fumaric acid, malic acid or oxaloacetic acid or a pharmaceutically acceptable salt thereof, wherein the solution or kit is essentially lacking in glutamic acid and glutamine.

40. A nutrient solution or a kit of pre-measured components for such a  
15 solution, the solution or kit comprising:

a nutrient-providing effective amount of carbohydrate;  
an oncotic agent in amount effective to provide, in conjunction with the other components of the solution, a physiologically acceptable oncotic pressure;  
and  
20 nutrient-providing effective amounts of amino acids or amino acid precursors including arginine, histidine, leucine, isoleucine, lysine, methionine, phenylalanine, threonine, valine, and at least one of citric acid, cis-aconitic acid, isocitric acid, succinic acid, fumaric acid, malic acid or oxaloacetic acid or a pharmaceutically acceptable salt thereof, wherein the  
25 solution or kit is essentially lacking in glutamic acid and glutamine.

41. A method of irrigating exposed cerebral-spinal tissue comprising irrigating with a solution comprising:

a nutrient-providing effective amount of carbohydrate;  
30 an oncotic agent in amount effective to provide, in conjunction with the other components of the solution, a physiologically acceptable oncotic pressure;  
and

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nutrient-providing effective amounts of amino acids or amino acid precursors including arginine, histidine, leucine, isoleucine, lysine, methionine, phenylalanine, threonine, valine, and at least one of citric acid, cis-aconitic acid, isocitric acid,  $\alpha$ -ketoglutaric acid, succinic acid, fumaric acid, malic acid or oxaloacetic acid or a pharmaceutically acceptable salt thereof, wherein the solution or kit is essentially lacking in glutamic acid and glutamine.

42. The method of claim 41, comprising conducting a surgery on  
10 cerebral-spinal tissue, the surgery comprising:

opening an animal to provide access to cerebral spinal tissue;  
irrigating the accessed cerebral spinal tissue; and  
conducting the surgery.

15 43. The method of claim 41, comprising conducting a surgery on  
cerebral-spinal tissue, the surgery comprising:

irrigating the exposed cerebral spinal tissue of an animal;  
conducting the surgery; and  
closing the animal to end the exposed state of the spinal tissue.

20 44. The method of claim 41, wherein the amino acids or precursors comprise  
tryptophan.

45. A method of delivering a physiologically acceptable solution or  
25 suspension to neural tissue of an animal having a cerebrospinal pathway, the method  
comprising:

conditioning the solution or suspension at temperature from within  $\pm 1$  °C of the  
physiological intracranial temperature ( $T_0$ ) of the animal;  
reducing the temperature of the conditioned solution or suspension by at least 2  
30 °C; and  
perfusing the reduced temperature solution or suspension through at least a  
portion of the cerebral spinal pathway.

46. The method of claim 45, wherein the temperature of the conditioned solution or suspension is reduced by 2 to 27 °C.

47. The method of claim 45, wherein the temperature of the conditioned  
5 solution or suspension is reduced by 5 to 15 °C.

48. A method of claim 45 of delivering a fluorocarbon nutrient emulsion to neural tissue of an animal having a cerebrospinal pathway, the method comprising:

10 oxygenating an emulsion of a poly-fluorinated, oxygen-carrying compound at a temperature from within  $\pm 1$  °C of the physiological intracranial temperature ( $T_0$ ) of the animal; reducing the temperature of the oxygenated emulsion by at least 2 °C; and perfusing the reduced temperature emulsion through at least a portion of the cerebral spinal pathway.

15 49. The method of claim 48, wherein the temperature of the oxygenated emulsion is reduced by 2 to 27 °C.

50. The method of claim 48, wherein the temperature of the oxygenated  
20 emulsion is reduced by 5 to 15 °C.